Medical Journal of Public Health
ISSN:
DOI:

RESEARCH ARTICLE OPEN ACCESS

Healthcare Expenditure, Socioeconomic Development, and Life Expectancy: A Cross-Country Panel Analysis of Global Health Outcomes

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Received:- 14/06/2026, Revised:- 15/07/2026, Accepted:- 21/07/2026, Published:- 29/07/2026

Abstract:

Wealth of the societies in general is regarded as one of the key drivers of health of the people and the role of healthcare spending on it may vary in the context of other socioeconomic and institutional factors. The research analyzed the correlation among healthcare expenditure, socioeconomic development level and life expectancy, based on the international panel data set of 3793 country-year observations from 179 countries from 2000 to 2022. The descriptive statistics, correlation analysis, country and year fixed-effects regression models, and robustness tests using alternative health financing indicators were applied. The descriptive results revealed that there was a strong positive correlation between the variables of healthcare expenditure per capita and life expectancy. After accounting for GDP per capita, urbanization, basic sanitation, government effectiveness, country-specific characteristics, and common time effects, however, the association of healthcare expenditure with the other factors described above was not statistically significant. In the fully adjusted model, only basic sanitation achieved statistical significance, suggesting that the provision of public-health facilities could play a significant role in longevity. Other indicators such as health expenditure as a share of gross domestic product, government health expenditure, government proportion of healthcare expenditure and out-of-pocket expenditure were also not significant on their own. The results imply that the direct cost of health care is not necessarily sufficient to improve health. To achieve sustainable improvements in life expectancy, health financing must work hand-in-hand with better sanitation, better governance, equitable access to services, and inclusive socioeconomic development

Keywords: Healthcare expenditure; Life expectancy; Socioeconomic development; Sanitation; Panel data

Introduction

The life expectancy is a broad measure of overall health of a population, which combines the impacts of access to health services, disease prevention, living conditions, income and education levels, sanitation and environmental quality and public governance. While life expectancy has increased dramatically over the years, there are considerable differences in life expectancy across countries and income groups. All these inequalities suggest that better population health is not dependent only on access to medical care, it also relies on the socioeconomic and institutional environment in which health care systems function. More recently, there is evidence that longer lifespan is not necessarily a longer period of healthy lifespan, which suggests the importance of considering determinants of health outcomes beyond health investment. (Garmany & Terzic, 2024). Generally, a rise in healthcare spending is believed to enhance life expectancy by increasing the availability of preventive care, medical technology, trained staff, drugs, and therapy.

There are cross-country indications that a positive link exists between the public health spending and the health outcomes, but the size of this relationship differs depending on the institutional and economic setting (Anwar et al., 2023). In developed countries, long-term investment in health, education and social protection has been associated with increases in life expectancy (Aytemiz et al., 2024). But the more you spend, the greater the health benefits are not necessarily. The health benefits are not always proportional to the increase in expenditure, especially if expenditure is misspent or goes to high-cost curative services. Healthcare expenditure and economic development go together closely. Economic growth increases government and household resources to pay for health, and better health can improve productivity and provide an element of long-term economic growth. The results of the OECD countries support this dynamic relationship between health expenditure indicators and economic growth (Beylik et al., 2022). Likewise, investment in health care has been linked to healthy life expectancy and economic productivity, suggesting that spending on health care can have population-health and economic returns (Ivankova et al., 2022).

Healthcare spending and life expectancy can also be mutually influential, as the historical increase in life expectancy has driven up demand for healthcare (Fonseca et al., 2021). However, the relationship is not as strong in different parts of the world. Healthcare spending and socioeconomic conditions have been found to account for important variations in life expectancy in South Asia (Dhungana et al., 2024). Indirect evidence from global dynamic panels has also suggested that a link exists between health expenditure and longevity and child mortality, but national income, population factors and institutional variables act as moderators of such relationships (Ray and Linden, 2020).

BRICS economies may also experience different impacts of health spending on life expectancy based on economic growth and environmental factors (Ridwan et al., 2026). The results suggest that the analysis of such expenditure needs to be examined in relation to socioeconomic developments and not just as a single determinant. It's not just about the volume of the spending, it's also about health financing arrangements. Evidence from across the country shows that financing systems have a differential effect on health system performance in terms of public pooling, insurance coverage, financial protection and accessibility of services (Gabani et al., 2023). High OOP payments can limit access to necessary health services and create a financial burden for low-income families in low-income communities (Voto & Ngepah, 2025). Financial inclusion could boost health via its ability to enable households to access services and cope with health shocks (Xiao & Tao, 2022). The need for continued public funding and coverage to mitigate catastrophic health costs (World Health Organization, 2021) has been highlighted in the expenditure reports. In addition, socioeconomic and infrastructural factors play a significant role in determining life expectancy. Global income inequality and multidimensional well-being shape the access to health opportunities at intra- and inter-country level (Geise & Szczepaniak, 2025). While urbanization may enhance access to health facilities and public services, equitable access to health services can also become a challenge in the event of rapid and uncoordinated urban growth, as well as the presence of environmental risk factors (Ge & Wu, 2025). Based on the literature found in Eastern Europe, income, education, healthcare resources and social factors are important factors that influence longevity (Țarcă et al., 2024).

Climate stressors can also impact health outcomes by increasing risk of exposure to infections, food insecurity, and heat-related deaths (Roy, 2024). The extent to which available resources are converted into health gains depends on institutional capacity. There is a large evidence base that shows that the efficiency of government is associated with the efficiency of care outcomes in general. This implies that the quality of public sector care affects the quality of health care spending (Ding et al., 2022). Monitoring, accountability and policy coordination are also crucial aspects to manage noncommunicable diseases (NCDs) and to secure long-term population health improvements (Mendis, 2026).There are international indicators of continuing governance gaps and inequities in progress on health-related development goals (Martins & Paes-Sousa, 2024).

More broadly, human-development data also indicate that economic instability, social insecurity, and inequities in access to public goods are a threat to health outcomes (Conceicao, 2022). There have been recent reports globally on how the pandemic affected health financing, health services delivery, and achievement of health-related development goals (World Health Organization, 2024c). Follow up evaluations indicate that healthcare systems are slowly recovering from the pandemic and are still under budget constraints, labor shortages, and inequalities (World Health Organization, 2024b).

These conditions highlight the need to test the extremes of inter-regional trends by methods which reflect both inter-national variation and common shocks to the global system. For this reason, the purpose of this study is to analyze and assess the relationship between health care expenditure, socioeconomic development and life expectancy in different countries in time. It spans a wide cross-section of countries in the world and takes a broad focus on health spending, economic growth, urbanization, sanitation, and government effectiveness in a single empirical model. The aims are to provide an account of variations in life expectancy and expenditure on healthcare across countries and time, to estimate the adjusted relationship between these two, to quantify how much of this relationship is driven by the country and by the time, to gauge the significance of the socioeconomic and institutional aspects, and to determine whether the results are robust enough to be found across different indicators of expenditure on healthcare.

2. Methodology

2.1 Research Design and Data Structure

This study used a quantitative, longitudinal and explanatory study with publicly available secondary data. Using the cross-country panel framework, the link between healthcare spending, socioeconomic development and life expectancy has been looked at over time. The number of observations in the final analysis-ready dataset was 3,793 country-years for 179 countries from 2000 to 2022. Unbalanced panel as countries have different numbers of observations available. The countries were identified for each observation by combining the country's three-letter international code with the year of the observation, creating a unique identifier for each observation (World Bank, 2024a, 2024b; World Health Organization, 2024a).Countries were added when data was available for the key variables in the empirical model. Data for regions and income groups were not aggregated, thus the analysis was based on the individual countries. The data from various international sources were harmonized by applying the same country codes, year format, measurement units and variable names. Observations for countries and years were duplicated and eliminated from the final panel.

2.2 Study Variables and Measurement

Life expectancy at birth (defined as the average number of years that a newborn would live if the mortality rates at that time continued into the future) was the dependent variable. Current health expenditure per capita (in PPP international dollars) was the principal independent variable. This choice was made because the measure will allow better comparisons among countries having different currencies and price levels. Gross domestic product per capita in constant 2021 purchasing-power-parity dollars (PPP) was the main indicator of socioeconomic development. Other socioeconomic and public health indicators were the percentage of the population residing in urban areas and the percentage of the population having access to basic sanitation services. Government effectiveness was added as an institutional control because its ability and quality of public administration may affect the efficient use of healthcare resources to produce outcomes for the population. Additional variables provided for extended and sensitivity analyses were healthcare expenditure as a percentage of gross domestic product (GDP), government's expenditure on healthcare per capita, government's expenditure on healthcare as a percentage of total current healthcare expenditure, out-of-pocket expenditure, secondary-school enrolment, access to basic drinking-water services, physicians per 1,000 population, and the proportion of the population aged 65 years and above. Healthcare-expenditure measures were not included in the main model at the same time since they were very similar concepts of health financing and are susceptible to multicollinearity.

2.3 Data Preparation and Management

The data was re-arranged into a common long format panel structure and joined by country code and year. The country names were kept throughout for presentation purposes, but country codes were used as standardized codes for merging and statistical work. Numeric variables were standardized to a common format and observations with missing country code, repeated country-year, or missing core variables were omitted. The distributions of expenditure on health care and of GDP per capita were also to be skewed towards the right because of the large differences between low-income countries, middle income and high income countries. As such, the variables were normalized by taking their natural log prior to regression analysis. The transformations also made the coefficients associated with the transformations proportional and reduced the impact of very large observations. Variables that were measured as life expectancy and percentage were left as such. Data quality was evaluated with range checks,

frequency distribution, missing-value checks and graphically. Values that were not feasible were checked against the original records instead of being assumed. Standardized values, boxplot and influence diagnostics were employed to identify extreme observations. Observations were not eliminated simply because they were statistically unusual since valid cross-country differences may result in true extreme values. Sensitivity analyses were designed to assess if there was a significant impact from influential observations on the estimated relationships.

2.4 Statistical Analysis

Descriptive statistics (Mean, Standard deviation, Median, Minimum, Maximum and Number of observations) were first computed for all the variables. Country, regional and income group differences were analyzed to provide a description of differences in healthcare expenditure, socioeconomic development and life expectancy. Preliminary associations among continuous variables were determined by calculating the Pearson correlation coefficient to determine the direction and strength of the relationship. The relationship between the principal and students was estimated in accordance with the two-way panel regression model:

$$LEit=\beta0+\beta1\ln HEit+\beta2\ln GDPit+\beta3URBit+\beta4SANit+\beta5 GEit+\mu i+\lambda t+\varepsilon it$$

where LE_it represents life expectancy in country during year t, ln(healthcare expenditure per capita) is denoted by ln(HE_it), the natural logarithm of GDP per capita is by ln(GDP per capita) or by GE_it, and the natural logarithm of the urban population is by URB_it, access to basic sanitation is by SAN_it represented by the natural logarithm of basic sanitation. The μ_i and λ_t terms are country and year effects, respectively, and ε_it is the error term. Country effects were included to account for unobserved country-level factors affecting the likelihood of the outcome, like geography, historical institutions, cultural conditions, or long-time health-system differences. Year fixed effects accounted for global shocks and common trends over time that are shared across countries. In addition, a random-effects model was estimated and the Hausman specification test was applied to test for consistency of the random-effects model. If cross-country correlations were detected among the country-level effects and explanatory variables, the fixed-effects model was then used as the key specification. Correlation coefficients and variance inflation factors were used to assess multicollinearity. The following panel-data diagnostic tests were conducted to test for heteroskedasticity, serial correlation, cross-section dependence, and residual distribution: Robust standard errors were clustered by country, to reflect heteroskedasticity and within-country correlation over time. The other expenditure measure used was healthcare expenditure as a percentage of GDP, government expenditure on health services and out-of-pocket expenditure in sensitivity analysis models. Coefficient estimates with 95% confidence intervals were computed and statistical significance was assessed at $p<0.05$ (two sided).

3. Results

3.1 Sample Characteristics and Descriptive Statistics

The final analytical sample consisted of 3,793 country-year observations for 179 countries covering the time period 2000-2022. The number of observations each year varied by country, making for an unbalanced panel. The average lifespan was 70.13 years (SD = 8.71) ranging from 14.67 to 84.56 years as presented in Table 1. The mean value of healthcare expenditure was 1,231.24 purchasing-power-parity international dollars per capita, but there was considerable positive skewness and large international variation, as shown by the considerably lower median of 591.41. The average GDP per capita was 21,817.25 constant 2021 international dollars and about 56.81% of the population resided in urban areas. 72.88% of the population had access to basic sanitation. The average government healthcare expenditure was around 50.15% of total current healthcare expenditure, while out-of-pocket expenditure was around 34.02% of total current healthcare expenditure. The findings highlight differences in economic development, financing of health systems, health infrastructure, and health-system outcomes among the countries included.

Table 1. Descriptive statistics of the study variables

Variable	N	Mean	SD	Median	Minimum	Maximum
Life expectancy, years	3,793	70.13	8.71	71.59	14.67	84.56
Healthcare expenditure per capita, PPP	3,793	1,231.24	1,664.62	591.41	10.11	27,553.63
GDP per capita, PPP	3,793	21,817.25	23,659.32	13,249.07	711.98	149,025.12
Urban population, %	3,793	56.81	22.57	58.51	8.04	100.00
Basic sanitation access, %	3,793	72.88	29.43	86.39	2.97	100.00
Government effectiveness	3,793	−0.02	0.96	−0.17	−2.44	2.47
Healthcare expenditure, % of GDP	3,793	6.20	2.84	5.64	1.22	24.46
Government healthcare expenditure per capita, PPP	3,793	796.07	1,177.07	290.55	0.77	8,393.73

Government share of current healthcare expenditure, %	3,793	50.15	21.76	51.26	0.79	97.12
Out-of-pocket expenditure, % of current healthcare expenditure	3,793	34.02	19.50	31.99	0.04	86.07

Note: PPP = purchasing power parity; SD = standard deviation.

Figure 1 shows the time trend of life expectancy at average level by income group. The average life expectancy was always higher for high-income countries, followed by upper- and lower-middle-income countries, respectively. Generally, the situation of low-income countries continued to be the worst, with some improvement over time. These inequalities have remained stable over time, indicating that global gains in life expectancy have not led to a substantial reduction in socioeconomic disparities in health status.

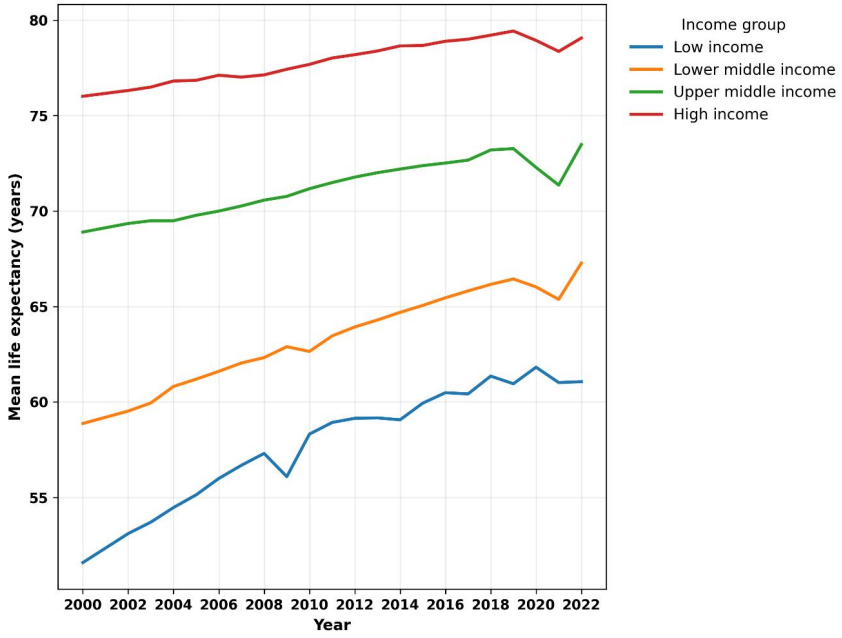

Figure 1: Trends in mean life expectancy by national income group, 2000–2022

3.2 Bivariate Relationships among the Study Variables

Healthcare expenditure per capita in natural log scale was strongly and positively associated with life expectancy (r=0.826, p<0.001) and GDP per capita in natural log scale was also strongly and positively associated with life expectancy (r=0.824, p<0.001). Basic sanitation had the highest bivariate correlation with life expectancy (r=0.845) (p<0.001). Government effectiveness also had a moderately strong positive relationship with life expectancy ((r=0.730), (p<0.001)), and urbanization, on the other hand, had a moderately strong positive relationship ((r=0.635), (p<0.001)). Healthcare expenditure and GDP per capita were significantly high correlated (r=0.935, p<0.001), with wealthier countries spending more on healthcare. This high correlation also suggested the small influence of each variable should be taken with a pinch of salt when both were present in the regression model. The table below (Table 2) presents the Pearson correlations between the variables of the study. There was a strong, positive correlation between life expectancy and the expenditure on health, GDP, sanitation, and effectiveness of government.

Table 2. Pearson correlations among the principal study variables

Variable	1	2	3	4	5	6
1. Life expectancy	1.000					
2. Log healthcare expenditure per capita	0.826***	1.000				
3. Log GDP per capita	0.824***	0.935***	1.000			
4. Urban population	0.635***	0.740***	0.754***	1.000		
5. Basic sanitation	0.845***	0.818***	0.815***	0.608***	1.000	
6. Government effectiveness	0.730***	0.792***	0.795***	0.542***	0.638***	1.000

*Note: (N=3,793). All monetary variables were entered in natural logarithmic form. ({}^{**}p<0.001).**

The relationship between spending and life expectancy has been adjusted for the effects of the ageing population and is illustrated in Figure 2. The higher the country's health spending, the longer the life expectancy. The curve,

however, levelled off at higher levels of expenditure, suggesting that, as expenditure increases, life expectancy changes less. But there was a significant amount of variation across countries that had similar expenditure levels, suggesting that differences in longevity were not solely attributable to differences in expenditure.

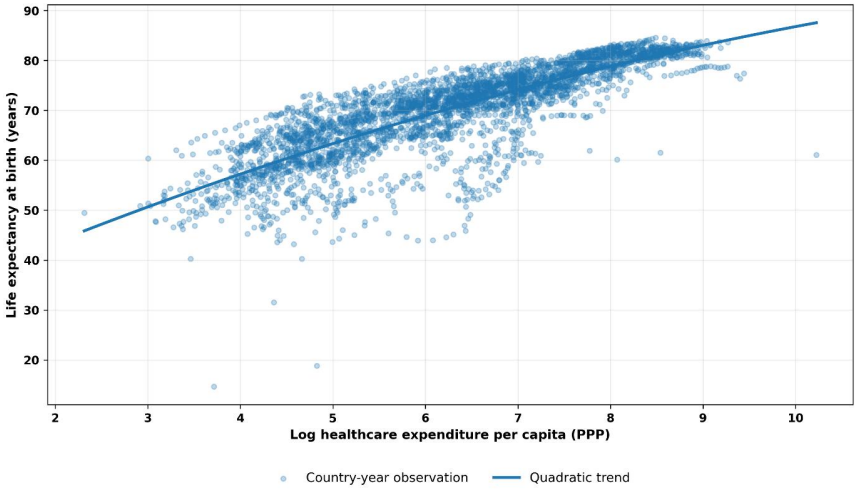

Figure 2: Relationship between healthcare expenditure per capita and life expectancy

3.3 Panel Regression Results

The two-way fixed-effects panel regression models are presented in Table 3 and robust standard errors are clustered by country. All models included country and year fixed effects. The increase in life expectancy was 0.46 years per increase in the log of healthcare expenditure in Model 1, where this variable was the main explanatory. This coefficient, however, was not statistically significant when controlling for country-specific and year-specific effects ((\beta=0.455), SE = 0.354, (p=0.199)). Following the addition of GDP per capita in Model 2, the coefficient of the healthcare-expenditure was negative but statistically insignificant ((\beta=-0.251), (p=0.581)). In this model, there was a positive and significant correlation between GDP per capita and life expectancy at birth ((\beta=2.241), SE = 0.797, (p=0.005)). However, when controlling for the other factors in the fully adjusted Model 3, healthcare expenditure was not independently associated with life expectancy (\beta=-0.116), SE = 0.435, (p=0.789)). Rather, GDP per capita was rendered statistically insignificant with the addition of sanitation, urbanisation and government effectiveness. Only basic sanitation was measured and was found to be a statistically significant predictor in the fully adjusted model. There was a positive association between increased access to basic sanitation and estimated life expectancy ((\beta=0.074), SE = 0.027, (p=0.006)) for a one-percentage-point increase in basic sanitation access. This is equivalent to about 0.74 more years of life expectancy per ten percentage points of sanitation coverage. The coefficients of urbanization ((\beta=0.035), (p=0.487)) and government effectiveness ((\beta=0.398), (p=0.232)) were also positive but non-statistically significant with life expectancy. With country and year fixed effects, the fully adjusted model accounted for about 96.75% of the total variation of life expectancy.

Table 3. Two-way fixed-effects regression of life expectancy.

Predictor	Model 1 β (SE)	Model 2 β (SE)	Model 3 β (SE)
Log healthcare expenditure per capita	0.455 (0.354)	−0.251 (0.455)	−0.116 (0.435)
Log GDP per capita	—	2.241** (0.797)	1.108 (0.838)
Urban population, %	—	—	0.035 (0.050)
Basic sanitation access, %	—	—	0.074** (0.027)
Government effectiveness	—	—	0.398 (0.333)
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	3,793	3,793	3,793
Countries	179	179	179
R^2	0.965	0.966	0.968

Adjusted R^2	0.963	0.964	0.966

Note: Dependent variable = life expectancy at birth in years. Country-clustered robust standard errors are reported in parentheses. ({}^{**}p<0.01).

The standardized coefficients from the fully adjusted model are shown in Figure 3. The most significant statistically reliable positive relationship with life expectancy was with basic sanitation. There was a positive relationship between increased sanitation coverage and extended life expectancy, with an estimated 2.17-year gain for every one-standard-deviation increment in sanitation coverage. The confidence intervals for health spending, GDP per capita, urbanisation and government effectiveness contained the null value.

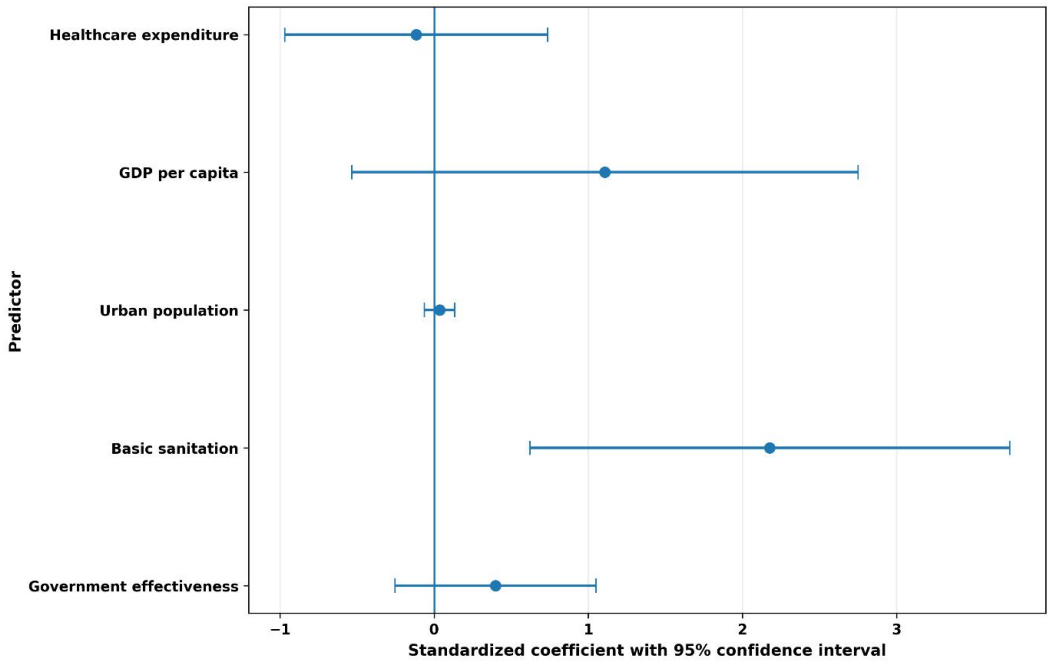

Figure 3: Standardized coefficients and 95% confidence intervals from the fully adjusted fixed-effects model

3.4 Healthcare-Expenditure Robustness Analysis

Other aspects of financing health care were added to the fully adjusted model separately to test the stability of the main finding. None of the indicators of health care expenditure proved to be statistically significant when country, year, socioeconomic conditions, sanitation, urbanization, and government effectiveness were controlled for life expectancy as shown in Table 4. There was no significant association of current healthcare expenditure as a percentage of GDP with life expectancy ((\beta=-0.044), (p=0.535)). The government expenditure on healthcare per capita (\beta=-0.283, (p=0.291)), the government share of healthcare expenditure ((\beta=-0.011, (p=0.315)) and the out-of-pocket share of healthcare expenditure ((\beta=-0.013, (p=0.277)) were not significant. The results were consistent, suggesting that national socioeconomic, infrastructural, institutional and time-invariant factors accounted for a large share of the strong unadjusted relationship between health expenditure and life expectancy.

Table 4. Robustness analysis using alternative healthcare-expenditure measurese null value.

Healthcare-expenditure measure	Coefficient	Clustered SE	p-value	N	Countries	R^2
Current healthcare expenditure per capita, log	−0.116	0.435	0.789	3,793	179	0.968
Current healthcare expenditure, % of GDP	−0.044	0.070	0.535	3,793	179	0.968
Government healthcare expenditure per capita, log	−0.283	0.269	0.291	3,793	179	0.968
Government share of current healthcare expenditure	−0.011	0.011	0.315	3,793	179	0.968
Out-of-pocket share of current healthcare expenditure	−0.013	0.012	0.277	3,793	179	0.968

Note: Each of the indicators for healthcare expenditures was included in a separate regression. They had all of the models controlling for log GDP per capita, urban population, basic sanitation, government effectiveness, year fixed effects and country fixed effects.

3.5 Comparative Trends by Healthcare-Expenditure Level

Life expectancy is compared by quartiles of annual healthcare expenditures in Figure 4. The highest expenditure

quartile countries had the highest average life expectancy while the lowest expenditure quartile countries had the lowest average life expectancy. Overall, both very low expenditure quartile and very high expenditure quartile group populations showed improvement over time for all groups, although the difference in outcome between these two groups was relatively large. These descriptive patterns are consistent with the notion that longer life expectancy is associated with greater healthcare resources, but the adjusted panel findings indicated that the association between healthcare expenditure and life expectancy is not statistically significant upon including other factors of development. Combined, the results indicate that the population-health impacts of health spending are shaped by the socio-economic and infrastructural and institutional context in which health spending takes place.

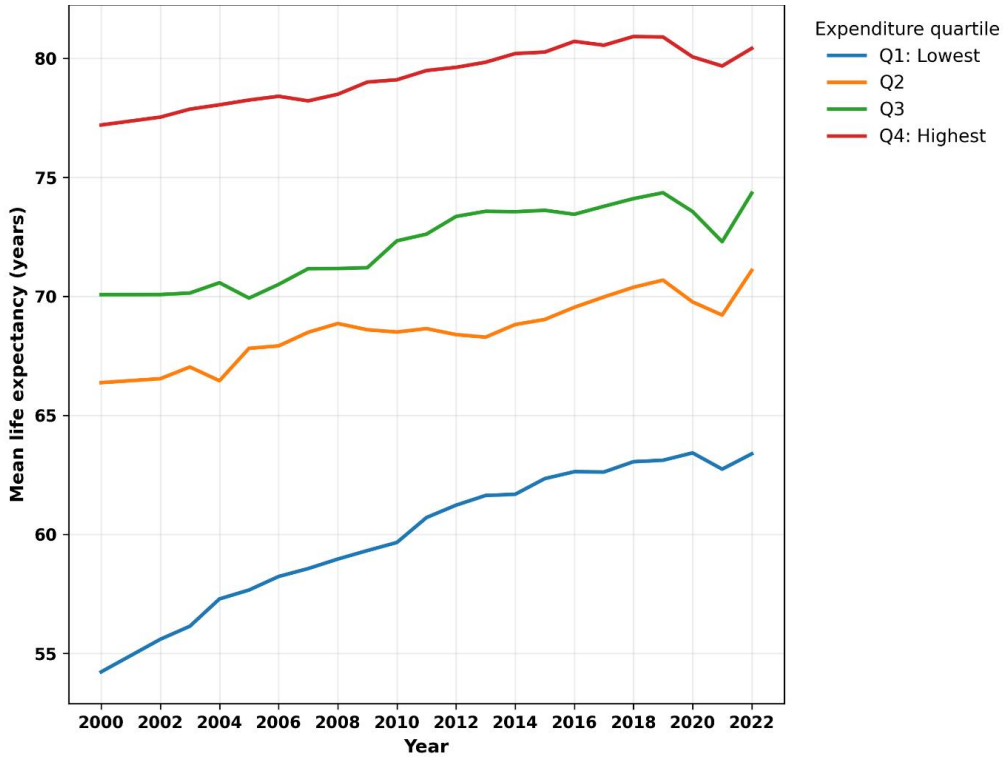

Figure 4: Mean life expectancy by annual healthcare-expenditure quartile, 2000–2022

4. Discussion

The findings demonstrate a strong descriptive relationship between healthcare expenditure and life expectancy across countries. Higher-spending countries generally reported longer average lifespans, and the correlation between healthcare expenditure per capita and life expectancy was substantial. This pattern is consistent with evidence showing that public health expenditure can improve access to services, prevention, and treatment, particularly where health systems possess sufficient institutional capacity (Anwar et al., 2023). It also supports research indicating that sustained social, educational, and health investments contribute to long-term improvements in longevity (Aytemiz et al., 2024).

However, healthcare expenditure was not statistically significant in the fully adjusted fixed-effects model. This result suggests that the strong cross-sectional association was largely explained by persistent national characteristics, economic development, infrastructure, and common temporal trends. Similar cross-country analyses have shown that the effect of healthcare financing depends on how resources are pooled, allocated, and translated into effective service delivery (Gabani et al., 2023). Therefore, countries with similar spending levels may achieve different outcomes because of differences in efficiency, coverage, governance, and disease burden.

GDP per capita was positively associated with life expectancy in the partially adjusted model but became nonsignificant after sanitation, urbanization, and government effectiveness were included. This indicates that economic development may influence longevity indirectly through better public infrastructure, improved housing, nutrition, education, and healthcare accessibility. Evidence from OECD countries likewise suggests that economic growth and health expenditure evolve together, making their independent effects difficult to separate (Beylik et al.,

2022). The result also supports the view that income alone is insufficient when economic gains are unevenly distributed or are not converted into broad social development (Geise & Szczepaniak, 2025).

Basic sanitation emerged as the only statistically significant predictor in the fully adjusted model. A ten-percentage-point increase in sanitation coverage was associated with an estimated increase of approximately 0.74 years in life expectancy. This finding highlights the importance of preventive public-health infrastructure in reducing infectious diseases, environmental exposure, and avoidable mortality. It also corresponds with evidence from Eastern Europe showing that social and infrastructural conditions are central determinants of longevity (Țarcă et al., 2024). The result implies that investments outside the formal healthcare sector may generate substantial population-health benefits.

Government effectiveness showed a positive but nonsignificant coefficient after controlling for country and year effects. Although the estimate was not statistically conclusive, its direction agrees with evidence that efficient public administration strengthens health policy implementation and improves health outcomes (Ding et al., 2022). Governance may influence longevity through resource allocation, regulation, surveillance, workforce management, and service coordination. Strong monitoring systems are particularly important for preventing and controlling noncommunicable diseases, which account for a growing share of global mortality (Mendis, 2026).

Urbanization was also positively related to life expectancy but did not independently predict the outcome in the fully adjusted model. Urban areas may provide better proximity to hospitals, skilled professionals, education, sanitation, and employment. Nevertheless, rapid urban expansion can create pollution, overcrowding, inequality, and unequal access to essential services (Ge & Wu, 2025). These competing pathways may explain the absence of a clear independent association after other development indicators were considered.

The robustness analyses showed that alternative health-financing measures—including health expenditure as a percentage of GDP, government expenditure per capita, the public share of health expenditure, and out-of-pocket expenditure—were not independently associated with life expectancy. These findings do not imply that healthcare financing is unimportant. Rather, they suggest that the amount or composition of expenditure alone may not capture healthcare quality, equity, efficiency, or access. In sub-Saharan Africa, out-of-pocket payments remain strongly shaped by the availability of government and external financing (Voto & Ngepah, 2025). Financial inclusion may also affect whether households can use available health services without experiencing severe financial hardship (Xiao & Tao, 2022).

The flattening of the expenditure–life expectancy curve at higher spending levels indicates diminishing returns. This pattern is plausible because basic healthcare investments may produce large improvements in lower-resource settings, whereas additional spending in high-income countries may be directed toward expensive technologies, chronic disease management, and end-of-life care. Historical evidence has similarly connected rising longevity with higher healthcare demand and expenditure (Fonseca et al., 2021). Thus, spending efficiency may become increasingly important as countries move to higher expenditure levels.

Regional evidence further indicates that the expenditure–longevity relationship is heterogeneous. Studies from South Asia report that health spending contributes to life expectancy but operates alongside income and social development (Dhungana et al., 2024). Findings from BRICS economies show that environmental pollution and economic growth can alter the health benefits of expenditure (Ridwan et al., 2026). Climate change may also reduce longevity through environmental and socioeconomic pathways that cannot be offset by healthcare spending alone (Roy, 2024). The high overall explanatory power of the fixed-effects models reflects the substantial role of persistent country characteristics and global time trends. International reports show that the pandemic affected healthcare spending, service continuity, and mortality patterns across countries (World Health Organization, 2024a). Recovery has remained uneven, with many systems facing constrained budgets and continuing service backlogs (World Health Organization, 2024b). Broader weaknesses in monitoring and global governance may further slow progress toward health-related development goals (Martins & Paes-Sousa, 2024).

The findings suggest that healthcare expenditure is necessary but not sufficient for improving life expectancy. Its effectiveness depends on economic conditions, sanitation, institutional capacity, equitable financing, and the broader social environment. The results support an integrated policy approach in which healthcare investment is accompanied by improvements in sanitation, governance, financial protection, and inclusive socioeconomic development.

5. Conclusion

Countries with a greater expenditure on health had longer life expectancy. But this correlation became weaker after adjusting for country-specific factors, year effects, and economic development, urbanisation, sanitation and government effectiveness. No statistically significant independent relation between healthcare expenditure per capita and life expectancy was detected in the fully adjusted model in the fixed-effects analysis. Likewise, the expenditures on health care as a fraction of GDP and government expenditure on health care, government proportion of total health expenditure, and expenditure out of pocket were not significant by themselves. The most

statistically significant predictor of life expectancy was basic sanitation, emphasizing the need for the public-health infrastructure and living conditions. In the presence of national and temporal effects, there were positive but statistically insignificant relationships between economic development, urbanization, and government effectiveness. The overall results show that increased health expenditure is not enough to reduce population-health outcomes. Health policies need to integrate effective health financing, with access to sanitation, robust governance, equitable health access, and inclusive socioeconomic development. Future studies should explore expenditure efficiency, healthcare quality, income inequality, environmental conditions, and regional differences to gain insights on the fact that countries with similar expenditure levels have different health outcomes.

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